

6. The Entozoa of the Hippopotamus. By ROBERT T. LEIPER, M.B., F.Z.S., Helminthologist to the London School of Tropical Medicine.

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(Text-figures 26-35.)

The parasites described in this paper were, with two exceptions, collected by me on the occasion of a visit to Uganda during the summer of 1907, as a member of the Egyptian Government Survey.

During a month's stay near the Murchison Falls on the Victoria Nile I dissected four Hippopotami for the purpose of ascertaining to what extent they harboured parasitic worms.

In every case worms were present in large numbers in the stomach, intestines, liver and subcutaneous tissues, comprising no less than *nine* species, of which *three* were round worms and *six* flat worms—no tapeworms occurred.

Shortly after my return to England I received from Dr. Sells, of the Uganda Medical Staff, a collection of parasites from various animals. Among these were two new species from the Hippopotamus that did not occur in my own series, but which for the sake of completeness are recorded here.

NEMATODA.

Family TRICHOSTRONGYLIDÆ.

Genus NEMATODIRUS.

1. NEMATODIRUS HOPKENI, sp. n. (Text-fig. 26, p. 234.)

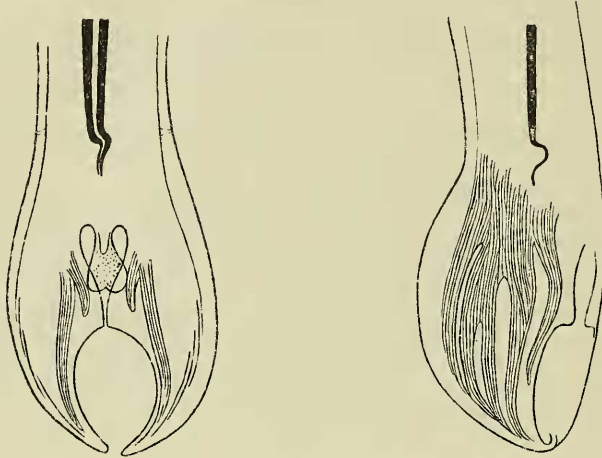
The habitat of this species is somewhat uncertain, as the few specimens representing it were found upon the peritoneal surface of the intestine and stomach after these had been opened. There seems little doubt that they had escaped from the stomach. The males are easily distinguished from the females by the presence of a bursa at their posterior ends and by their smaller size. The males measure 12 mm. and the females 18 mm. in length. The skin is transversely striated, and the striæ at the level of the junction of œsophagus with intestine are 0·003 mm. apart.

The mouth is unarmed, but is surrounded by three tiny lips.

The œsophagus is simple and gradually increases in diameter from its anterior to posterior end. At 0·3 mm. from the mouth it is crossed by the nerve ring, and at the same level the excretory pore opens on the ventral surface of the body. In the male, the bursa surrounding the posterior extremity consists of two long lateral flaps supported by six rays. The third or posterior membrane with its supporting posterior ray is entirely absent.

The spicules are equal in length and measure 0.43 mm. and are of a brown colour; they have a peculiar and characteristic shape—the proximal part is of uniform diameter, and then quite suddenly tapers to a sharp point; this attenuated portion resembling a note of interrogation. There are two small pre-bursal papillæ.

Text-fig. 26.

*Nematodirus hopkeni.*

Bursa of male, showing absence of posterior lobe.

Cervical papillæ are present in both sexes: they project as acicular points 0.4 mm. behind the nerve-ring. In the female the œsophagus measures 1.5 mm. in length. The anus is 0.25 mm. from the tip of the tail. The vulva lies 3.83 mm. in front of the anus. There is a short vagina of 0.1 mm., into which two uteri open; these uteri are provided with ovejectors. The ova are thin-shelled and measure 0.065 by 0.035 mm. I name this species in honour of Baron Hermann v. Höpken, companion of our wanderings in Uganda.

Family FILARIDÆ.

Genus FILARIA.

2. FILARIA HIPPOPOTAMI, sp. n. (Text-fig. 27 A, p. 236.)

A couple of days after the dissection of one of the Hippos from which the previously described material was obtained, I happened to inspect some large pieces of the skin that my gun-bearer had saved, and was drying in the sun. My attention was attracted by the numerous white lines resembling pieces of cotton that interlaced the strands of connective tissue still adherent to the under surface of the skin. These on closer examination proved to

be calcified filaria worms. A prolonged search resulted in the discovery of four living specimens, but unfortunately they were all females, and the description of the species must necessarily remain incomplete for the present.

The parasites measure 100 mm. in length and have a transverse diameter of 0·4 mm. The skin is quite smooth, the mouth is simple, and does not appear to be provided with definite papillæ. The œsophagus, like that of other filaria in mammals, is long and slender, measuring 2·6 mm. by 0·12 mm. At 0·5 mm. from the mouth it is crossed by the nerve-ring. The anus is situated 0·45 mm. from the tip of the tail. The vulva opens 1·55 mm. from the anterior end. The vagina is a muscular-walled tube passing directly backwards therefrom to divide at the level of the junction of the œsophagus with the chyle intestine into two long uterine tubes. These tubes are at first narrow (0·05 mm.) and pass backwards for a considerable distance side by side; they become distended later with embryos, and together with the ovarian tubules occupy the perivisceral cavity from 0·8 mm. behind the vulva to the anus.

The posterior end of the worm is bluntly rounded, and in the middle line terminates in a small cuticular knob with a slightly depressed tip. On either side of this cuticular termination the integument is distinctly raised by a pair of large fleshy papillæ.

This species is apparently closely related to *Filaria demarquai* of man.

3. COBBOLDIA VIVIPARA, gen. et sp. n. (Text-fig. 27 B, C.)

The mucous secretion upon the lining of the stomach of the Hippopotamus was infested with myriads of a minute form of Nematode that is, when alive, almost invisible to the naked eye on account of its transparency. The males and females resemble each other very closely, and can only be distinguished by a microscopical examination. The former measure 4·0 mm., the females 4·3 mm. in length. The skin has no transverse striæ, but longitudinal lines are visible through the cuticle. In the male the body maintains an almost uniform diameter of 0·09 mm. from the excretory pore to the genital opening. The body tapers anteriorly from the excretory pore to 0·03 mm. at the head, and likewise posteriorly from the anus to end at the tail in an acicular point. In the female a uniform diameter of 0·1 mm. is only maintained in the second quarter of the body length, whence it tapers gradually to 0·04 mm. at the head, and uniformly through the whole of the posterior half of the body to a sharp-pointed tail similar to that in the male.

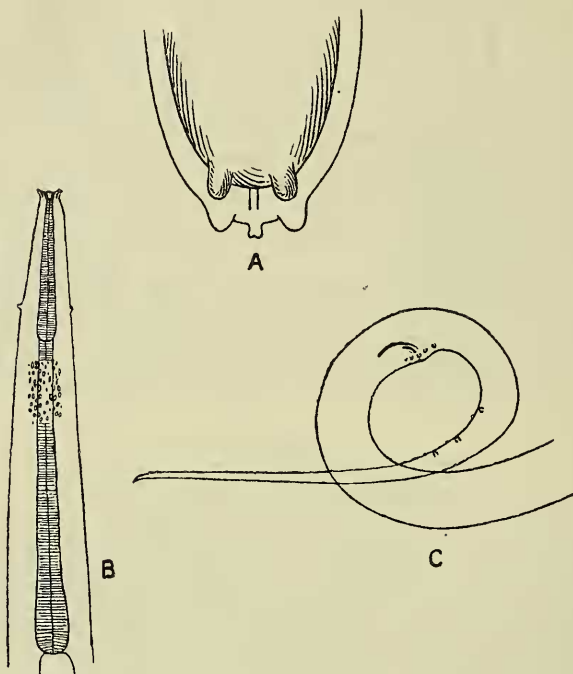
The mouth is surrounded by a collar of cuticle which has a median triangular prolongation on its dorsal and ventral aspects. The whole collar is supported by four finger-like papillæ, the lateral pair supporting the apices of the triangular flaps being twice the length of the median pair which maintain the basal angles.

The œsophagus is long and slender and becomes bulbous in its posterior fourth; it unites with the chyle intestine at 0.65 mm. from the mouth in both sexes.

The nerve-ring is very broad (0.01 mm.) and surrounds the œsophagus in its middle third at 0.25 mm. from the head.

The excretory pore opens 0.5 mm. from the anterior end of the body.

Text-fig. 27.



A. *Filaria hippopotami*. Tail of female.

B (head) and C (tail of male) of *Cobboldia vivipara*.

In the male the testicular tube pursues an almost straight course alongside of the intestine from the cloaca to within 0.5 mm. of the œsophagus, then sharply doubles upon itself for 0.24 mm. and ends in a blunted tip.

The two spicules are short undulating chitinous rods with fine transverse markings; they measure 0.26 mm. and 0.055 mm. in length.

The genital papillæ are sessile and consist of a circumanal group of five pairs, and in addition there are four pairs of post-anals distributed along the tail at gradually diminishing distances from each other.

In the female the anus opens 0.95 mm. from the posterior extremity. The vulva is 0.07 mm. in front of the anus. The anatomy of the female organs cannot be accurately determined as these structures are greatly distended by two or three embryos of enormous size, the containing cyst measuring 0.3 mm. by 0.1 mm. This retention of the ovum within the maternal body until it has completed its larval development and has attained adult form, is found also in *Probstmayria vivipara* which occurs in horses in various parts of the world.

I have named this genus in honour of the late Dr. Cobbold.

CESTODA.

No tapeworms were present in any of the animals examined. Cobbold mentions that "Livingstone has drawn attention to the fact that the river-horse is much infested by tapeworms," but I cannot find a description of such parasites anywhere in literature.

TREMATODA.

Family FASCIOLIDÆ.

Genus FASCIOLA.

4. FASCIOLA NYANZÆ, sp. n. (Text-fig. 28, p. 238.)

This species was found exclusively in the bile-ducts of the liver, and in most instances the specimens were somewhat macerated owing to the length of time that necessarily elapsed before the animal could be recovered from the water.

The genus *Fasciola*, in the restricted sense in which it was used first by Cobbold, comprises only the species *F. hepatica*, *F. gigantica*, *F. magna*, from Ruminants, and *F. jacksoni* from Elephants. These four species differ mainly in the shape and size of the body, the character of the internal branches of the gut and the distribution of the yolk-glands, especially with reference to their encroachment upon that region of the body which lies between the main gut branches. *F. nyanzæ* is more closely related to *F. hepatica* and *F. gigantica* than to the other forms, differing mainly in the feeble development of spines on the integument, and the restriction of the branched testes to the anterior third of the body.

Form, etc.—The parasite measures 69 mm. in length; greatest breadth 9.3 mm., *i. e.* in the proportion of 7 to 1, whereas in *F. hepatica* the proportion is only 2 to 1, and in *F. gigantica* 4 to 1.

The cephalic cone is well defined and when contracted measures 3 mm. in length.

The body expands almost immediately behind the cone to attain its greatest diameter, whence it tapers very uniformly to the posterior end of the body, having midway a diameter of only 6 mm., and 3 mm. at less than 2 mm. from the posterior end.

The oral sucker measures 0.9 mm. broad by 0.7 mm. long. The musculature is 0.3 mm. thick. The ventral sucker lies at the base of the cephalic cone, is spheroidal and has an antero-posterior diameter of 1.25 mm., and its muscular wall is 0.4 mm. in thickness.

The alimentary canal has a well-developed pharynx and an exceedingly short œsophagus. The two guts give off numerous external ramifying branches. The internal branches on the other hand are relatively few, and resemble those of *F. hepatica*. They rarely branch.

Text-fig. 28.

*Fasciola nyanzæ*. Nat. size.

- a. Gut branches uncovered by yolk-glands.
- b. Upper limit of yolk-glands.
- c. Area occupied by testes.
- d. Area occupied by yolk-glands.

The yolk-glands are very extensive and occupy the whole of the posterior 44 mm. of the body; they extend forwards also on either side of the testes to the level of the shell-glands, leaving the "shoulders" of the parasite free for over 2 mm.

The greatly ramified testes lie in the anterior third only of the body, and in comparison with the other forms occupy a relatively small area.

The specimens were not sufficiently well preserved to allow of the differentiation, by staining, of the branched ovary from the testes. The uterine coils lie immediately behind the ventral sucker, and are few in number. They contain numerous large dark brown eggs ovoid in shape and measuring 0.15 mm. by 0.07 mm.

Family PARAMPHISTOMIDÆ.

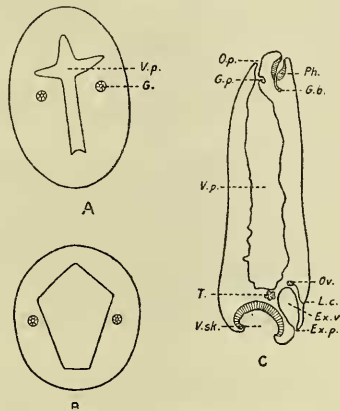
Genus GASTROTHYLAX.

5. GASTROTHYLAX CRUCIFORMIS, sp. n. (Text-fig. 29 A, B, C.)

This species occurred in considerable numbers associated with *Paramphistomum buxifrons* in the stomach. When alive the specimens are of a deep red colour which changes to brown after preservation in formalin. They have the characteristic form of

Gastrothylax. The body measures 0·5 mm. to 0·8 mm. in length, and is cylindrical in shape, tapering to a blunt point anteriorly, the posterior end being truncate and occupied by the terminally situated ventral sucker 0·9 mm. in dorso-ventral diameter, with a muscular wall 1·8 mm. thick. All the specimens obtained were sexually immature, but the peculiar configuration of the ventral pouch is alone sufficient to distinguish this from all previously described forms. The entrance to the cavity of this pouch is a transverse slit on the ventral surface, 0·35 mm. from the oral opening. When seen in sagittal section the cavity has an almost uniform breadth of 0·5 mm. from a short way behind the genital pore to its blind end upon the dome of the ventral sucker. In transverse section the cavity maintains a distinctly pentagonal

Text-fig. 29*.

*Gastrothylax cruciformis*.

A, B. Transverse sections. C. Median longitudinal section.

shape in all degrees of contraction of the body; the base of the pentagon lying parallel to and upon the ventral surface, and the apex projecting towards the dorsal surface of the parasite. In certain conditions of contraction the two sides that form the apical angle and the side that forms the base frequently buckle so as to produce the figure of a cross; under no circumstances are the five angles obliterated.

The cuticle is thin and smooth, with tiny knob-like papillæ near the mouth.

The pharynx is small, globular, and measures 0·32 mm. in length and 0·26 in breadth, the muscular wall being 0·09 mm. in thickness.

The œsophagus measures 0·2 mm. in length and 0·08 mm. in breadth.

* For explanation of abbreviations used in the text-figures see p. 251.

The gut-branches have a width of 0.06 mm. and follow a wave-like course to end at the level of and ventral to the testes.

The genital opening lies immediately behind the pharynx and discharges into the narrow channel leading into the ventral pouch. It lies in front of the bifurcation of the gut.

The genital atrium is 0.1 mm. deep and 0.1 mm. wide.

The testes are small rosette-like bodies lying one on either side of the middle line in the pad of parenchymatous tissue that intervenes between the blind end of the ventral pouch and the dome of the ventral sucker. They measure in my immature specimens 0.2 mm. in diameter. The various parts of the genital tube cannot be satisfactorily delimited as the worm had not reached sexual maturity.

The yolk-glands are undeveloped in the specimens.

The ovary rests upon the fundus of the excretory vesicle on the connective tissue between the ventral pouch and the dorsum.

The shell-glands are undeveloped; their rudiment lies just ventral to the ovary.

The uterus contains no eggs.

Laurer's canal crosses over the fundus of the excretory vesicle to open opposite its centre.

Excretory vesicle is a large egg-shaped cavity 0.6 mm. in length by 0.3 mm. in breadth, lying with its longitudinal axis parallel to that of the body. Its posterior more pointed half rests upon the dorsal surface of the ventral sucker. The excretory duct is very short (0.07 mm.) and passes diagonally from the excretory vesicle to the dorsal surface. The excretory pore lies at a distance of 0.36 mm. behind Laurer's canal, which curves over the fundus of the vesicle.

Genus PARAMPHISTOMUM.

6. PARAMPHISTOMUM GIGANTOCOTYLE Brandes. (Text-fig. 30.)

Otto and Buchner have previously found this species in small numbers, but only the former has given any account of the parasite. Otto's description is very incomplete, and on some points is apparently incorrect. No mention is made of the pharyngeal pouches, or of the openings of Laurer's canal and excretory vesicle. He states that there is only one testis. I attribute my specimens to this species mainly on the ground of the presence of an exceedingly large ventral sucker.

Form, etc.—The body is pyriform, the anterior being the pointed end. It measures 8 mm. in length and 2.75 mm. in greatest diameter. The dorsal surface is markedly convex, and the large ventral sucker presents entirely on the ventral aspect of the body. This sucker has an antero-posterior internal diameter of no less than 3.2 mm., and its wall is 0.4 mm. in thickness. The opening of the sucker varies considerably in size in different specimens: in well-preserved ones its usual diameter is about 1.6 mm., in macerated worms it may exceed even 4 mm.

The cuticle is smooth and there are no papillæ surrounding the mouth.

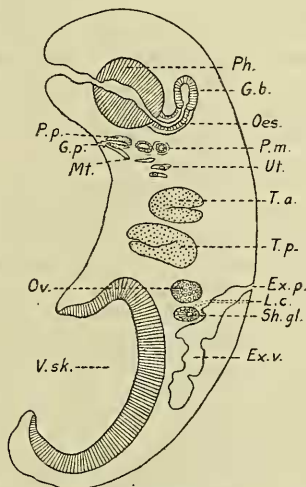
The pharynx is oval, and measures 1.1 mm. in length by 1 mm. in transverse diameter, and its musculature has a thickness of 0.4 mm. There are no pharyngeal pouches.

The œsophagus is S-shaped, measures 0.9 mm. in length by 0.2 mm. in breadth. The musculature of its wall is only slightly developed.

The bifurcation of the gut lies anterior to the genital pore on a level with the posterior fourth of the pharynx.

The gut-branches have a width of 1 mm. and end blindly upon the sides of the ventral sucker at the level of its lower lip.

Text-fig. 30.



Paramphistomum gigantocotyle. Median longitudinal section.

The genital opening lies on the ventral surface midway between the mouth and the anterior limit of the ventral sucker. The genital atrium is slit-like. Its wall is strengthened by some thickening of the subcuticle.

The testes, two in number, are deeply incised transversely so as to give to each the appearance, in some sections, of two distinct bodies. Otto makes the statement that there is only one testicular mass. The testes are almond-shaped: they lie in contact, one behind the other, with their longitudinal axis, 1.1 mm., at right angles to that of the body. The maximum antero-posterior measurement is 0.5 mm.

The yolk-glands consist of numerous very small follicles scattered throughout the parenchymatous tissue on the outer aspects of the voluminous gut-branches.

The ovary occupies the centre of the triangular area limited by the testis anteriorly, the anterior half of the excretory vesicle dorsally, and the dome of the ventral sucker ventrally; it has a diameter of 0·5 mm.

The shell-glands lie in the posterior angle of the same area just below the ovary.

Laurer's canal crosses the excretory vesicle near its duct, and opens upon the dorsum lateral to and behind the excretory pore.

The excretory vesicle is an elongated fissure-like cavity 2·2 mm. long and 0·3 mm. wide. It discharges by a duct only 0·15 mm. in length on the dorsal surface, at a point in line with the anterior borders of the ventral sucker and the ovary.

A few specimens of this species occur in Dr. Sells' collection.

7. PARAMPHISTOMUM BUXIFRONS, sp. n. (Text-fig. 31.)

Enormous numbers of this species were found in the stomach, attached to the mucous membrane. They are readily distinguishable by their brownish pigmentation and leaf-like shape. For the present the species is placed in the genus *Paramphistomum*, but it departs very considerably from the type as defined by *P. cervi* in shape of the body, the position of the ventral sucker, and the relation to each other of the two testes.

Form, etc.—The body is very similar in shape to the leaf of the box tree, and on this account *buxifrons* has been selected as the specific name of the parasite. The measurements vary very considerably with the amount of contraction of the individual specimens. A large example may measure 5 mm. by 3 mm. in breadth, and be only 0·4 mm. in thickness at the middle of the body. Contracted specimens have a transversely corrugated ventral surface and a distinctly convex but smooth dorsal surface. The posterior end is always truncated, and the ventral sucker opens quite terminally. This sucker has a dorso-ventral diameter of 0·7 mm., its wall is 0·3 mm. at its thickest part, and its aperture is 0·15 mm. wide. The cuticle is smooth, but there are digitate papillæ surrounding the mouth, and the subcuticle on the ventrum is pigmented and markedly thickened (0·01 mm.), and the cuticle covering it thrown into irregular transverse folds.

The pharynx is pyriform, 0·45 mm. long by 0·24 mm. broad, and the musculature is 0·08 mm. at its thickest part. There are no pharyngeal pouches.

The œsophagus has a length of 0·24 mm. and is 0·035 mm. in breadth. Its wall is fairly strongly developed and measures 0·04 mm. in thickness. The whole œsophagus lies anterior to the level of the genital pore.

The gut-branches are about 0·06 mm. wide; they pursue a serpentine course and terminate about 0·1 mm. in front of the ventral sucker.

Genitalia.—The genital opening lies at the junction of the anterior quarter with the rest of the body, 0·5 mm. behind the

bifurcation of the gut. The genital atrium is small; its wall is formed by a thickening of the subcuticle.

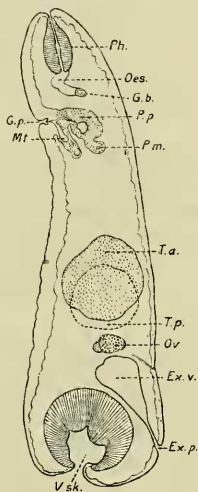
The testes, two in number, are large, smooth, spheroidal bodies occupying the anterior third of the posterior half of the body, and are situated diagonally one slightly behind the other. They measure 0.55 mm. antero-posteriorly, and 0.5 mm. dorso-ventrally, occupying practically the whole space between the dorsal and ventral integuments.

The vesicula seminalis is small and characterised by very few coils.

The pars musculosa is short, well defined, and provided with a thick muscular coat.

The pars prostatica has a greatly thickened wall composed mainly of secretory cells.

Text-fig. 31.



Paramphistomum burifrons. Median longitudinal section.

The ductus ejaculatorius measures 0.04 mm. in length, uniting with the metraterm to form the ductus hermaphroditicus and so discharges into the slit-like atrium.

The yolk-glands are poorly developed and lie wholly outside the gut-branches; the follicles are small and measure 0.1 mm. by 0.05 mm. in diameter.

The ovary lies between the testes and the excretory vesicle; it measures 0.25 mm. by 0.13 mm.

The shell-glands lie lateral to and in contact with the ovary.

The uterus has few coils.

Laurer's canal passes outwards from the ovary to the dorsal

surface of the body, passing over the fundus of the excretory vesicle and opening 0.53 mm. in front of the excretory pore.

The excretory vesicle is pear-shaped, measures 0.7 mm. in length by 0.3 mm. in greatest breadth at the fundus, tapering gradually as it passes backwards to terminate in the excretory duct, 0.1 mm. in length, that opens on the dorsal surface in the middle line and at the level of the centre of the ventral sucker.

The median longitudinal serial section of the parasite from which the above measurements were all derived measured 3.5 mm. in length, 1 mm. at the level of the dome of the ventral sucker, 0.65 mm. at the level of the genital pore dorso-ventrally.

8. PARAMPHISTOMUM MINUTUM, sp. n. (Text-fig. 32.)

Among the specimens of *P. buxifrons* collected from the stomach were seen a number of very minute forms distinguished by the absence of pigment. These were at first regarded as young forms of *P. buxifrons*, but on cutting serial sections of two or three of them I was surprised to find that they were sexually mature, and that in each the uterus contained eggs. In other respects, especially in the structure of the genital atrium, they differed markedly not only from *P. buxifrons* but also from the other amphistomes.

Form, etc.—The body is oviform in shape and measures 2.7 mm. in length by 0.7 mm. in thickness. The ventral sucker lies subterminally and measures 0.66 mm. in diameter; its musculature is 0.28 mm. thick at the dome, its cavity is 0.46 mm. wide, and its aperture is 0.32 mm. The cuticle is smooth and of uniform thickness on the dorsal and ventral surfaces. There are a few papillae around the mouth.

The pharynx is globular in shape, measuring 0.45 mm. long by 0.3 mm. broad, with a musculature of 0.14 mm. at its thickest part. There are no pharyngeal pouches.

The oesophagus is 0.18 mm. in length and has a diameter of 0.08 mm. The bifurcation of the gut lies behind the genital atrium, which opens at the level of the junction of the oesophagus and pharynx. The two gut-branches have a width of about 0.1 mm., and end after a tortuous course just anterior to the ovary.

The genital pore opens at the junction of the anterior fifth with the rest of the body, immediately behind the pharynx.

The genital atrium has a well-developed muscular wall 0.1 mm. in thickness and sharply delimited from the surrounding parenchyma.

The testes are relatively very small in size, oval in shape, and measuring only 0.2 mm. antero-posteriorly by 0.15 mm. dorso-ventrally; they lie one in front of the other in the middle line of the body, but nearer the ventral than the dorsal surface, and their longitudinal axis is placed at an angle of 30° ventral to the median line of the body. If the body length be divided into two equal

parts, the anterior border of the front testis marks the commencement of the second portion. The testes are separated from each other by a space equivalent to their antero-posterior diameter.

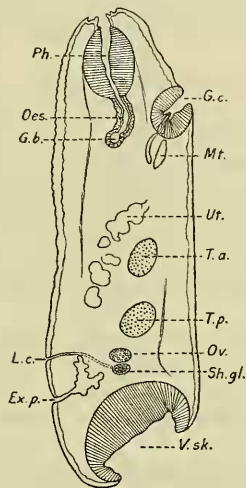
The vesicula seminalis is represented by a small rosette-like coil of the genital tube midway between the anterior testis and the bifurcation of the gut. It merges into the pars muscosa, a short feebly developed portion about 0.15 mm. long.

The pars prostatica, 0.15 mm. in length, is straight and has a fissure-like cavity. It discharges by the penile ductus ejaculatorius that protrudes into the metraterm.

The ductus hermaphroditicus, 0.1 mm. in length, projects like the tip of a finger into the atrium for a distance of 0.03 mm.

The yolk-glands form two vertical rows around the gut-branches, and range from the bifurcation of the gut to the level of the ovary.

Text-fig. 32.



Paramphistomum minutum. Median longitudinal section.

The ovary is spheroidal and is placed dorsad of and slightly posterior to the testis.

The shell-glands lie immediately behind the ovary, resting upon the anterior wall of the excretory vesicle.

The uterus is filled with eggs and passes into the metraterm 0.3 mm. behind the atrium.

Laurer's canal passes outwards from the level of the shell-glands to open some little distance in front of the excretory pore; it does not cross any portion of the excretory vesicle or duct.

The excretory vesicle is small and, as seen in vertical section, has an exceedingly irregular outline. It lies almost wholly in

front of, and somewhat dorsal to the ventral sucker. It discharges at its posterior limit by a short, straight, thick-walled duct that runs out to the dorsal surface parallel to, and 0.25 mm. behind Laurer's canal.

9. *PARAMPHISTOMUM SELLSI*, sp. n. (Text-fig. 33.)

The specimens contained in one of the tubes sent to me by Dr. Sells showed such marked variations in shape that at first I separated them into three well-defined groups, thinking that these would prove on further study to represent distinct though closely allied species. A comparison of serial sections of these forms has convinced me, however, that they represent merely different degrees of contractility in one and the same species. One stage showed distinct dorso-ventral flattening approaching in appearance the outline of a Polyclad Turbellarian. The second stage resembled in outline an ordinary Amphistome with the ventral sucker presenting wholly on the under surface. In the third stage the worm assumed an elongated form not unlike an ear of wheat: the posterior sucker having become completely everted and presenting terminally.

The parasite measures from 4 mm. to 6 mm. in length, and varies considerably in breadth. The ventral sucker opens on the under surface at the posterior end of the body, except in greatly elongated examples as already mentioned. Its greatest diameter is 0.53 mm., its cavity is 0.4 mm. in width, and the musculature has an almost uniform thickness of 0.13 mm.

The cuticle is but feebly developed all over the body, having a thickness of less than 0.01 mm. Surrounding the anterior end of the body are numerous fungoid papillæ arranged in parallel rows.

The pharynx is flask-like in shape, and is much less strongly developed than in the other Amphistomes. It measures in length 0.35 mm., in breadth 0.27 mm., and its musculature has a depth of only 0.1 mm. at its thickest part. There are no pharyngeal pouches.

The œsophagus is 0.5 mm. in length, 0.07 mm. in breadth, with a very thin muscular sheath.

The gut-branches are 0.2 mm. broad in front of the ventral sucker, and end about the level of the fundus of the excretory vesicle.

The genital opening lies at the junction of the anterior third with the rest of the body, and is situated at about 0.5 mm. behind the bifurcation of the gut. There is a large genital atrium exceeding in size the oral sucker and having an aperture of 0.3 mm. and a depth of 0.3 mm.; its muscular wall is 0.15 mm. thick, and is sharply marked off from the parenchym.

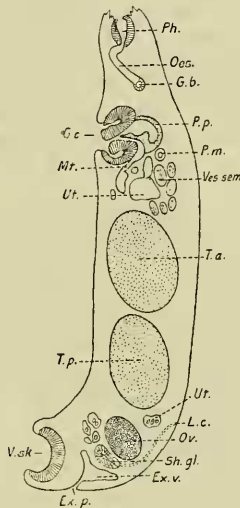
The testes lie in contact, one in front of the other, in the posterior half of the body, are oval in shape, and are not lobed; they have a diameter antero-posteriorly of 1.0 mm. and dorso-ventrally of 0.7 mm.

The vesicula seminalis is a wide tube filling with its coils almost the whole space between the atrium and the anterior testes.

The pars musculosa is, on the other hand, almost absent, and is represented only by a narrow duct discharging by a tiny pore into the pars prostatica, a sausage-like dilated cavity.

The ductus ejaculatorius is funnel-like, its thick muscular walls are really a portion of the atrial musculature. It is 0.14 mm. in length and unites with the metraterm to form the ductus hermaphroditicus, which discharges upon the summit of an enormous muscular pad.

Text-fig. 33.



Paramphistomum sellsi. Median longitudinal section.

The yolk-glands extend from behind the pharynx to the sides of the ventral sucker; they are arranged in single file and the follicles are clumped into masses of enormous size, measuring each about 0.2 mm. in diameter.

The ovary is large and oval, placed with its greatest diameter (0.5 mm.) dorso-ventrally between the posterior testis and the fundus of the excretory vesicle.

The shell-glands lie immediately behind the ovary and occupy almost wholly the space intervening between it and the excretory vesicle.

The uterus passes dorsally over the testes following a fairly straight course, and discharges into the metraterm 0.75 mm. from its union with the ductus ejaculatorius.

Laurer's canal runs from the shell-glands in an anterior direction, passing the ovary dorsally to open in the middle line at the

level of the posterior edge of the second testis; it does not cross the excretory vesicle in any part of its course.

The excretory vesicle as seen in longitudinal section is Y-shaped, embracing the shell-glands within its two arms; its cavity merges almost insensibly into the short excretory duct which passes backwards to open at the level of the dome of the ventral sucker 1.2 mm. behind Laurer's canal.

The above measurements are all taken from serial sections of a single specimen 6 mm. in median longitudinal section.

10. PARAMPHISTOMUM PISUM, sp. n. (Text-fig. 34.)

This form, unlike those hitherto described, lives in the small intestine. It is white in colour with the faintest tinge of pink. In shape it is pisiform, but the specimens preserved all exhibit a certain amount of contraction. The ventral sucker lies subterminally, and its aperture as seen with the naked eye is a minute pore no larger than that of the mouth (0.3 mm.). Its greatest diameter is 1.7 mm.; the muscular wall is 0.4 mm. thick, the cavity 1.0 mm. wide.

The dorsal cuticle is 0.02 mm. thick and is differentiated into two parts, the external layer being 0.01 mm. thick, and there do not appear to be any papillae at the anterior end of the body. The cuticle on the ventral surface is very thin.

The pharynx lies some distance (0.9 mm.) from the oral pore, is globular in shape, 1.2 mm. long, 1.1 mm. broad, and its muscular wall is 0.4 mm. thick. There are no pharyngeal pouches.

The œsophagus is short, exceedingly wide, and in contracted specimens shows several transverse folds. Its wall has thick strands of muscle. It measures 0.3 mm. in length by 0.6 mm. in breadth.

The gut-branches are also very wide, measuring 0.6 mm.

The genital pore lies only 0.9 mm. behind the oral opening (and in contracted specimens) at the level of the centre of the pharynx.

The genital atrium is small and fissure-like, and its wall is composed of an inward extension of the sub-cuticle, which is sharply marked off from the parenchym. A few muscular fibres are seen in its wall.

The testes are large and deeply lobed: they lie in the ventral half of the body, and occupy almost the whole of that region between the pharynx and the ventral sucker. It is impossible from serial sections to ascertain exactly their individual size; they appear to lie one in front of the other.

The vesicula seminalis is a thin-walled voluminous tube crowded with sperm-cells. It completely fills the ventral half of the area intervening between the bifurcation of the gut and the anterior testis.

The pars muscosa is spirally coiled and there is a fair amount of contractile tissue in its wall.

The pars prostatica is pyriform, but, for the size of the animal, is relatively small.

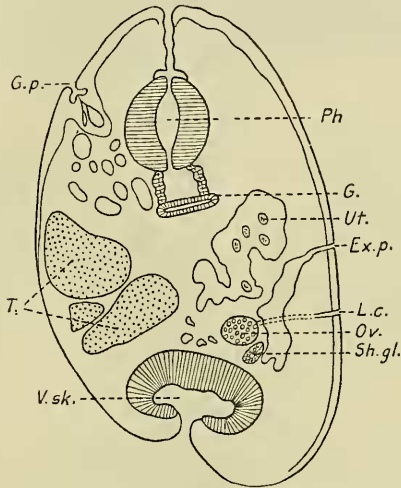
The ejaculatory duct is only 0.01 mm. long.

The ductus hermaphroditicus is about the same length and opens upon a stunted crateriform thickening of the atrial wall.

The yolk-glands extend from the level of the base of the oral opening to that of the dome of the ventral sucker. They also stretch inwards dorsally over the gut towards the middle line. The follicles are large, irregularly arranged masses, 0.5×0.3 mm.

The ovary is an oval body 0.8 mm. in dorso-ventral and 0.45 mm. in antero-posterior diameter, lying almost in contact with the dome of the ventral sucker.

Text-fig. 34.



Paramphistomum pisum. Median longitudinal section.

The shell-gland mass is situated lateral to, and a little behind, the ovary. It lies in contact with the dome of the ventral sucker and the under surface of the posterior half of the excretory vesicle.

The uterus is a widely dilated tube almost 1 mm. in diameter, filled with eggs measuring 0.15×0.07 mm.

Laurer's canal follows an almost straight course from the shell-glands to the dorsal surface, crossing the excretory vesicle at about its middle and opening about 1.4 mm. behind the excretory pore.

The excretory vesicle discharges by an excretory pore situated about 1.4 mm. in front of Laurer's canal, and from this opening its fissure-like cavity (0.15 mm. wide) stretches backwards towards the dome of the ventral sucker for a distance of 1.5 mm.

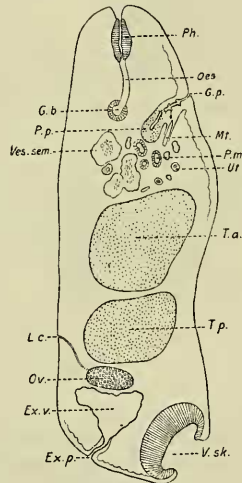
11. PARAMPHISTOMUM COTYLOPHORUM Fiscoeder.

A phial sent by Dr. Sells and labelled "from the Hippopotamus" contained a number of specimens of this species. As *P. cotylophorum* is by far the commonest parasite of cattle, buffaloes and antelopes in Uganda, it is by no means impossible that infection of the Hippopotamus may occur. On the other hand, there may have been a mistake in the labelling, for another phial of similar forms "from a Buffalo" was received at the same time.

12. PARAMPHISTOMUM WAGANDI, sp. n. (Text-fig. 35.)

A few specimens of this species occur in Dr. Sells' collection. They are small and whitish and fairly closely resembling grains of boiled rice. The specimens have a length, in section, of 3.5 mm. and a dorso-ventral diameter of 1.2 mm., and are very like *P. sellsi* in outward appearance. The genital pore is, however, very minute, and a genital sucker is absent.

Text-fig. 35.

*Paramphistomum wagandi*. Median longitudinal section.

The pharynx is poorly developed when compared with other forms. It is elongated in shape, measuring 0.3 mm. in length, 0.14 mm. in greatest diameter, and has a musculature of 0.07 mm.

The oesophagus measures 0.33 mm. in length and bifurcates at the level of the genital pore.

The ventral sucker lies subterminally and has a transverse measurement of 0.5 mm. The musculature of its dome is 0.2 mm. thick. The dorso-ventral diameter of its cavity is 0.37 mm.

The excretory vesicle lies dorsal to and slightly in front of the

ventral sucker. It is pyriform in shape and discharges posteriorly by a short thick-walled canal 0.16 mm. long in the mid-dorsal line, 0.6 mm. in front of the lip of the ventral sucker, and 0.9 mm. behind Laurer's canal.

The genitalia discharge by a small common pore at the level of the bifurcation of the gut. The arrangements of the various structures in this region are well shown in text-fig. 35.

The testes are two large round or ovoid bodies 0.45 mm. by 0.6 mm. in diameter, lying one in front of the other, the posterior resting upon the ovary and shell-gland.

The ovary is elongated dorso-ventrally, being wedged in between the posterior testis and the fundus of the excretory vesicle. It measures about 0.25 mm. by 0.09 mm.

The shell-glands form a well-defined mass lying slightly to one side of the ovary. From them Laurer's canal can be traced forwards and to the dorsal surface to discharge there at about the level of the centre of the posterior testis and in the middle line 0.9 mm. in front of the excretory pore.

EXPLANATION OF ABBREVIATIONS USED IN THE TEXT-FIGURES.

<i>Ex.p.</i> Excretory pore.	<i>Ph.</i> Pharynx.
<i>Ex.v.</i> Excretory vesicle.	<i>P.m.</i> Pars musculosa.
<i>G.</i> Gut, main branch.	<i>P.p.</i> Pars prostatica.
<i>G.b.</i> Gut bifurcation.	<i>Sh.gl.</i> Shell-gland.
<i>G.c.</i> Genital cup.	<i>T.</i> Testis.
<i>G.p.</i> Genital pore.	<i>T.a.</i> Anterior testis.
<i>L.c.</i> Laurer's canal.	<i>T.p.</i> Posterior testis.
<i>Mt.</i> Metraterm.	<i>Ut.</i> Uterus.
<i>Oes.</i> Œsophagus.	<i>V.p.</i> Ventral pouch.
<i>O.p.</i> Orifice of ventral pouch.	<i>V.sk.</i> Ventral sucker.
<i>Ov.</i> Ovary.	<i>Ves.sem.</i> Vesicula seminalis.

February 15, 1910.

Dr. S. F. HARMER, M.A., F.R.S., Vice-President,
in the Chair.

The Secretary read the following report on the additions made to the Society's Menagerie during the month of January 1910:—

The number of registered additions to the Society's Menagerie during the month of January last was 117. Of these 72 were acquired by presentation, 7 by purchase, 2 were received on deposit, 31 in exchange, and 5 were born in the Gardens.

The number of departures during the same period, by deaths and by removals, was 199.

Amongst the additions special attention may be directed to:—

One English Wild Bull (*Bos taurus* var.), born in the Menagerie on Jan. 14th.

One Eland (*Taurotragus oryx*) ♀, born in the Menagerie on Jan. 20th.

One Congo Marsh-Buck (*Limnotragus gratus*), born in the Menagerie on Jan. 14th.

One Sambur Deer (*Cervus aristotelis*), born in the Menagerie on Jan. 25th.

Four Persian Gazelles (*Gazella subgutturosa*) 1 ♂, 3 ♀, from Meshed, presented by Capt. J. W. Watson, I.M.S., and Major R. L. Kennion, I.S.C., F.Z.S., on Jan. 8th.

One Wood-Brocket (*Mazama nemorivagus*), from Brazil, presented by Frederick Burgoyne, Esq., F.Z.S., on Jan. 31st.

One Mallee Bird (*Leipoa ocellata*), from Australia, deposited on Jan. 24th.

Mr. James F. Ochs, F.Z.S., exhibited twelve heads of Wapiti, *Cervus canadensis typicus*, obtained by Mr. A. Williamson in 1879 on the Piney Range, Rocky Mountains, and the head of a Bison, *Bos bison*, which had formed part of a collection of hunting trophies that had been presented to the Royal Automobile Club by Mr. Williamson.

The following are the measurements in inches of the horns of the five largest Wapiti heads:—

Points	13	16	14	12	16
Length	59, 59½	56, 59	51, 55½	51, 54½	52, 53
Span	50	45	45	42	51
Girth round burr	13	15½	12	12¾	12½
Girth above burr	10½	12½	10¼	11¼	10½

Mr. Charles Urban, F.Z.S., Managing Director of the Natural Colour Kinematograph Co., Ltd., gave a display of motion pictures of animals which had been exhibited hitherto in this country only before T.M. the King and Queen at Knowsley, the Society of Arts, and the Palace Theatre, London. The pictures had been taken, with one or two exceptions, at the Society's Gardens in Regent's Park, and at the National Zoological Park, Washington, U.S.A. Mr. John Mackenzie, the expert who had photographed the animals, introduced and explained the series and the processes which had been employed in obtaining them.

The coloured pictures obtained by the Urban-Smith system of Kinemacolor were particularly successful in reproducing faithfully various shades of yellow, grey, and brown, the films exhibiting the Giraffes feeding and the Elephants bathing being strikingly good, whilst some of the brightly coloured birds were extremely interesting. A series of uncoloured films gave faithful and pleasing representations of various animals in movement, some of them displaying the effect on the animals of gramophone music.
